

## Cooperative learning approaches in Mathematics: A literature review

Bhuvaneshwari, (Research Scholar), Faculty of Education, Banaras Hindu University, Varanasi- 221010.

Dr. Meenakshi Singh (Professor), Faculty of Education, Banaras Hindu University, Varanasi- 221010.

### Abstract

*This review paper focuses on cooperative learning in mathematics teaching. Cooperative learning has been strongly advocated as an important teaching approach in schools for a number of years. A review of the research regarding the effectiveness of cooperative learning methods (particularly student teams) indicated that when the classroom is structured in a way that allows students to work cooperatively on learning tasks, students benefit academically as well as socially. The greatest strength of cooperative learning methods is the wide range of positive outcomes that have been found in the research. Cooperative learning methods are usually inexpensive and easy to implement. Teachers need minimal training to use these techniques. The widespread and growing use of cooperative learning techniques demonstrates that, in addition to their effectiveness, they are practical and attractive to teachers.*

**Key words:** *Cooperative learning Mathematics, Teaching Methods,*

### Introduction

Man is a social animal and therefore mankind has the tendency to live together. A group of individuals make a society. Without the cooperation of its members a society cannot survive, and the societies world wide have survived because the cooperativeness of its members made survival possible. In the context of students, school is also a society. The school curriculum enables students to learn many social values in groups, further such learning is fun and without any burden. Educators have given serious thought to making learning enjoyable through group- interactions among the students. Group learning basically works on the thought that the two heads learn more than one. Such type of learning is known as cooperative learning. Cooperative learning is a student-centered, instructor-facilitated instructional strategy in which a small group of students is responsible for its own learning and the learning of all its group members. Students interact with each other in the same group to acquire and practice the elements of a subject matter in order to solve a problem, complete a task or achieve a goal.

Thus we can say, cooperative learning is an approach to group work that minimizes the occurrence of those unpleasant situations and maximizes the learning and satisfaction that result from working on a high-performance group. A large and rapidly growing body of research confirms the effectiveness of cooperative learning in education. Relative to students taught traditionally—i.e., with instructor-centered lectures, individual assignments, and competitive grading—cooperatively taught students tend to exhibit higher academic achievement, greater persistence through academic session, better high-level reasoning and critical thinking skills, deeper understanding of learned material, greater time on task and less disruptive behavior in class, lower levels of anxiety and stress, greater intrinsic motivation to learn and achieve, greater ability to view situations from others' perspectives, more positive and supportive relationships with peers, more positive attitudes toward

subject areas, and higher self-esteem. Another non-trivial benefit for instructors is that when assignments are done cooperatively, the number of papers to grade decreases by a factor of three or four.

There are several reasons why cooperative learning works as well as it does. The idea that students learn more by doing something active than by simply watching and listening, has long been known to both cognitive psychologists and effective teachers. Cooperative learning is by virtue of its nature an active method. Beyond that, cooperation enhances learning in several ways. Weak students working individually are likely to give up when they get stuck; working cooperatively, they keep going. Strong students faced with the task of explaining and clarifying material to weaker students often find gaps in their own understanding and fill them in. Students working alone may tend to delay completing assignments or skip altogether. Cooperative learning is one of the main instructional strategies that can be used to propel them altogether. When they know that others are counting on them, they are motivated to do the work in a timely manner.

It is a basic theory of cooperative learning that when group members are linked together in such a way so they perceive that they cannot succeed unless they all do, they will actively assist each other to ensure that the task is completed and the group's goal obtained (Deutsch, 1949). They achieve this by providing help and assistance with the task, sharing resources, and encouraging each other's efforts. As a consequence, group members who work in cooperative groups outperform students who work by themselves or in competition with each other (as they do in traditional classrooms) (Johnson & Johnson, 1999). Furthermore, cooperative learning, as a teaching pedagogy, capitalizes on adolescents' desires to engage with their peers, exercise autonomy over their learning, and express their desires to achieve (Slavin, 1996). In fact, it has been argued that cooperative learning experiences are crucial to preventing and alleviating many of the social problems related to children, adolescents, and young adults (Johnson, Johnson, & Stanne, 2000). Certainly, the social benefits that accrue to students from cooperative learning experiences have been well documented (Jordan & Le Metaias, 1997; Kamps, Dugan, Leonard, & Daoust, 1994; Slavin, 1995). Numerous studies have reported the benefits that accrue from cooperative learning experiences.

In cooperative learning the teacher designs the social interaction structures as well as learning activities (Kagan, 1989). Johnson, Johnson and Holubec (1993) state that in cooperative learning students can maximize their own and each other's learning when they work together. Slavin (1996) argues that a critical element of cooperative learning is group team work and team goals. Critical features of group interaction include the level of elaboration of help given and received and the responsiveness of help to the needs of students. Important predictors of group interaction included student ability, gender and personality, and group composition on ability and gender. Possible strategies for promoting effective small-group interaction include using certain group compositions, altering the reward structure, providing training in desirable verbal behavior, and structuring the group activity to require students to give explanations to each other (Webb, 1991).

### **Cooperative learning used as pedagogy at primary level**

Cooperative learning gave rise to learning opportunities that do not typically occur in traditional classrooms, including those that arise from collaborative dialogue as well as from the resolution of conflicting points of view. The nature of these learning opportunities is elaborated and

illustrated. The manner in which the teacher used paradigm cases as he/she initiated and guided discussion of obligations and expectations to make possible the mutual construction of classroom norms for cooperative learning is also illustrated. Small-group problem solving was used as a primary instructional strategy for all aspects of second-grade mathematics, including computation, for the entire school year. The use of cognitively based activities designed to be problematic for children at a variety of conceptual levels constituted the crucial features of a cooperative learning environment in the absence of extrinsic rewards (Erna Yackel, Paul Cobb & Terry Wood 1991).

The effects of cooperative learning on the achievement in and attitude towards mathematics, of a group of 5<sup>th</sup> grade students from the United States (i.e. Bermuda), by Student Team Achievement Division (STAD) method of cooperative learning in mathematics, revealed positive gains in attitudes and achievement (Vaughan, 2002; Brush 1997; Zakaria et al, 2010).

Another study was designed to compare the effects of Team Assisted Individualization (TAI) and Student Teams-Achievement Divisions (STAD) on fourth grade students' academic achievement in and attitudes towards mathematics. After analyzing the data pairwise comparisons showed that the TAI method had a more significant effect than the STAD method and no significant difference was observed regarding students' attitudes towards mathematics (Kamuran Tarim & Fikri Akdeniz, 2008). TAI can have a strong positive effect on the social acceptance and behavior of academically handicapped students (Slavin, 1983).

The positive effects of cooperative learning would generalize to private elementary schools, comparing mathematics achievement, friendship, attitude toward mathematics and self-concept outcomes of students taught with and without cooperative learning. Significant increase in mathematics achievement surfaced for cooperative learning groups but only differential effects for cooperative learning with the three affective students' outcomes (Jacob et al. 1996). Cooperative learning can be successfully applied in teaching verbal mathematics problem-solving skills during the preschool period. The preschoolers' skills regarding cooperation, sharing, listening to the speaker and fulfilling individual responsibilities in group work improved. The teachers' points of view also supported these findings (Kamuran Tarim, 2009)

Perihan Dinc Artut (2009) investigated the effects of cooperative learning on the mathematics ability and cooperative social behaviours of kindergarten children and to evaluate teachers' perspectives on the application of the program. Significant improvements in mathematics abilities were found for children in the experimental group that utilized cooperative learning.

The effects of student-teams using mastery learning strategies (STML) on mathematics achievement of fifth-grade children showed higher achievement gains for pupils exposed to STML than for those exposed through more traditional instruction. The data further indicated that learning in small groups promoted only computational skills whereas mastery learning strategies improved both computation and comprehension. In addition, the benefits of the methods for high-, medium-, and low-ability students were examined and discussed (Zemira R. Mevarech, 1985)

### **Cooperative learning used as pedagogy at above primary level**

A study investigated the effects of cooperative learning on junior high school students who worked in structured or unstructured cooperative groups. The results show that the children in the structured groups were more willing to work with others on the assigned tasks and they provided

more elaborate help and assistance to each other than their peers in the unstructured groups. Furthermore, as the children in the structured groups had more opportunities to work together, they developed a stronger perception of group cohesion and social responsibility for each other's learning than their peers in the unstructured groups (Robyn M. Gillies, 2004) also students in the study performed better than those in traditional sections; their attitude towards mathematics improved; they actually participated in outside classroom work and became more interested in and motivated to do mathematics; and the majority of the students were positive about the instructional approach and thought this method was a better way for them to learn mathematics (Mohammad H. Ahmadi, 2000) and cooperative group learning strategies are more effective in promoting mathematics achievement (Reid John, 1992; Effandi Zakaria, Lu Chung Chin and Md. Yusoff Daud, 2010)

The effects of cooperative learning on student achievement and attitudes in a secondary mathematics classroom were investigated. Survey results revealed primarily favorable responses toward the cooperative learning procedure. Most students indicated that they liked working in groups and appreciated getting help from other students, especially for learning difficult concepts. Some students disliked having groups preassigned and permanent, and they suggested alternating group membership (Whicker, Bol & Nunnery, 1997). It is found that there were no gender differences in students' mathematics achievement after their being taught scale-drawing topic through STAD, co-operative learning strategy (Njoro and Githua, 2013).

Teske (2003) studied "Cooperative Learning: A Sixth Grade Mathematics Curriculum For Teaching Addition Of Fractions" and conclusions reached were that "Sixth grades students who had been working with fractions since third grade and had still not developed proficiency needed learning activities that were engaging and encouraged them to take an active role in their learning. This study provided teachers with a guide to implement hands-on and group based activities in their classrooms that increase student achievement with fractions.

Leikin and Zaslavsky (1997) investigated the effects of learning mathematics in a cooperative small group setting on different types of students interactions in low-level ninth grade classes. Findings indicate an increase in students' activity, a shift toward on-task verbal interaction, various opportunities for students to receive help and positive attitudes towards the cooperative experimental method. Cooperative small-group setting indicated (a) an increase in students' activeness, (b) a shift toward students' on-task verbal interactions, (c) various opportunities for students to receive help, and (d) positive attitudes toward the cooperative experimental method (Roza Leikin & Orit Zaslavsky 1997). Cooperative structures address different student learning styles in every class, including verbal, visual, and kinesthetic. (Panitz, Theodore, 2000)

Davidson & Kroll (1991) found that the effect of cooperative learning of mathematical skills were consistently positive when there was a combination of individual accountability and some form of team goal or team recognition for commendable achievement. Time and practice are necessary to build trust and to develop the informal and formal operating procedures that enable teams to work together effectively (Korinek, McLaughlin, & Walther-Thomas, 1999). When choosing their own groups, students often create groupings that promote or reinforce status hierarchies (Mitchell, Reilly, Bramwell, Solnosky, & Lilly, 2000).

Cooperative learning can be effective when students and teachers take on their roles within the

classroom. Successful cooperative learning groups will 1) have more talk that evaluates the group product; 2) show less off-task behavior; 3) have better group products; 4) write better final essays on the academic content of the unit (Cohen, Lotan, Abram, Scarloss, & Schultz, 2002).

Cooperative learning is grounded in the belief that learning is most effective when students are actively involved in sharing ideas and work cooperatively to complete academic tasks (Zakaria and Iksan, 2007). The investigators examined the extent to which teacher interventions focused on students' mathematical thinking in naturalistic cooperative-learning mathematics classroom settings. They also observed 6 videotapes about the same teaching content using similar curriculum from 2 states. They created 2 instruments for coding the quality of teacher intervention length, choice and frequency, and intervention (Meixia Ding et al., 2007). As such, cooperative learning can effectively be implemented to improve students' achievement in secondary mathematics (Aziz, 2010), decrease mathematics anxiety in students significantly, increase help seeking behaviour and decrease its avoidance component at them (Lavasania 2011).

Mulryan (1989) investigated the behavior and perceptions of high and low achieving fifth and sixth-grade girls and boys. The findings revealed that students manifested more time-on-task in the cooperative small-group setting than in the whole-class mathematics and reading group settings. High achievers manifested more time-on-task and also more quality involvement than did low achievers in cooperative small groups. Students' and teachers' perceptions were related to student behavior in cooperative small groups. High achievers were more active participants than low achievers were in the groups. The interview responses of low achievers indicated that these students have less complex and less differentiated understanding of the nature of cooperative small-group work. Cooperative learning strategy is more effective than competitive learning strategy and that boys performed significantly better than girls in both learning strategies (E. B. Kolawole, 2008).

## Conclusion

It may be concluded that the above review of researches finds positive outcomes in the areas of student achievement, attitude, integration, mainstreaming, and self-esteem. Cooperative learning is essential if mathematics teachers are to change the students' perceptions, their ability to discuss, and their perception of working with one another in maths. Cooperative learning involves more than simply assigning students to groups and telling them to work together. There are many ways that groups can be non-productive. In order to be cooperative, a lesson must be well-defined, open for discussion, and have positive face-to-face interaction. The cooperative learning groups should be teacher-generated rather than student-selected. When done correctly, cooperative learning tends to promote student relationships, more positive attitudes toward mathematics and the teacher, and greater self-confidence in a student's mathematics.

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